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Classification Algorithms Research on Facial Expression Recognition

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Abstract

In order to improve the reliability of facial expression recognition system, and reduce the chance of false positives caused by error, classification strategy is important in recognition process. In the process, the k-nearest neighbor algorithm is improved. Experimental results show that the performance of the proposed method is excellent when it is applied to facial expression recognition system.

Keywords- Classification algorithms; Facial expression recognition; Feature characterization

1. Introduction

Nowadays, there has been a growing interest in improving aspects of the interaction between humans and computers. It is argued that the facial expressions play an essential role in social interactions with other human beings. Facial expression is a major way of human emotional communication. It is a visible and mutative manifestation of human cognitive activity and psychopathology. It is reported that facial expression constitutes 55% of the effect of a communicated message while language and voice constitute 7% and 38% respectively. With the rapid development of computer vision and artificial intelligence, facial expression recognition becomes the key technology of advanced human computer interaction. More and more people have been paying attention to expression recognition. The research objective of facial expression recognition is how to automatically, reliably, efficaciously use its conveying information. It is a typical issue in model-identification that the automatic recognition system's property is decided by the represented facial expression feature. Therefore, the feature extraction is very important to the facial expressions recognition process. If inadequate features are provided, even the best classifier could fail to achieve accurate recognition. In most cases of facial expression classification, the process of feature extraction yields a definitively large number of features and subsequently a smaller sub-set of features needs to be selected according to some optimality criteria. The k-nearest neighbor algorithm has been proved to be effective for expression recognition because of closest training examples in the feature space. KNN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. According to the needs of special vision, it can adjust

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the spatial and frequency properties to face expression characteristic wanted, so Gabor filter wavelet is suitable for people face analysis and treatment of expression[1][2].

In this paper, it should pay attention to extract features useful for classification and recognition. The object is the static image. It can obtain the static image utilizing the video tools. The method is simple. It can reliably extract the typical feature and acquire the higher recognition rate. It would utilize the responses of the filters which is six orientations and six scales. Experimental results show that the performance of the proposed method is excellent when it is applied to automatic facial expression recognition system.

The remainder of this paper is organized as follows: Section 2 of the paper describes the classification algorithms' principle, property and the feature characterization in detail. Then the adaptation scheme for choosing the orientation and frequency of the filter to extract the facial expression feature will be performed. In Section 3,some experimental results are shown and explained. Finally, conclusions and future work are given in Section 4.

2. Classification algorithms

Classification analysis is an important component of facial recognition, mainly used for finding the valuable data distribution and data models in the potential data. At present it has further study of the database, data mining, statistics and other fields. It has achieved great success. Classification can be defined as follows: Given n data points of d-dimensional space, divided into k groups, which meets the largest similarity with group and the smallest similarity between groups. The data points within a cluster are more similar to each other than that in different clusters. Firstly, obtain the initial k-partition, and then use iterative positioning technology, trying to move an object from one class to another for improving the quality of classification.

K-mean algorithm idea is to gather each element to its most close heart-shaped (mean) class. Basic steps:[3]

a) The object is roughly divided into K initial classes;

b) The object individually is assigned to its closest mean class. The new object class and the loss object class mean is re-calculated;

c) Repeat step 2 until no various elements are in and out. At the beginning, the object isn't assigned to K pre-specified classes. It can also specify K seed points, and then proceed to Step 2. To some extent, the final clustering result dependents on the initial division or seed points selection. However, its class size is little different and it is very sensitive to the dirty data.

K-medoids method selects an object called "medoid" instead of the central role in K-mean algorithm, such a "medoid"to identify this class[4].

Input: K is the number of clusters, and the database contains N data objects.

Output: K-clustering classes which meet the standard minimum variance.

Processes:

a) Choose K objects from N data objects as initial cluster center;

b) Repeat;

c) Assign each of the remaining objects to the nearest cluster represented by the center;

d) Select randomly a non-center object —Orandom;

e) Calculate of the total cost of E, using Orandom instead of Oj

f) IF E <0, THEN replace Oj with Orandom, forming a new set of K center points

This algorithm is not sensitive to dirty and abnormal data, but the calculation is clearly larger than the K- mean, generally only suitable for small data.

CLARANS algorithm[5] (a Clustering Large Algorithm Based on Randomized Search) is a partition rather than the hierarchical clustering method. It first randomly selects a point as the current point, and then checks a number of adjacent points randomly around no exceeding the parameter Max neighbor. If find a better neighbor than the points, put it into adjacent points, or set the point as a local minimum. Then, randomly select a point to find another local minimum until find the number of local minimum to meet the user requirement. The algorithm requires that the cluster object must be transferred to the memory, and need to repeatedly scan the database. But for large databases, whether time complexity or space complexity,

it is not applicable. Although the R tree structure is introduced to improve its performance, enabling it to deal with the large disk-based database, but the construction and maintenance of R tree is too costly. The algorithm is not sensitive to dirty data and abnormal data. It is very sensitive to data order, and can only deal with convex or spherical boundary clustering.

The classification of these patterns is done through K nearest neighbour (KNN)[6][7][8][9][10]classifier. The K Nearest Neighbour (KNN) finds out the K nearest neighbours to a test case from the training cases, based on the Euclidean distances between them. The testing examples are vectors in a multidimensional feature space, each with a class label. The training phase of the algorithm consists only of storing the feature vectors and class labels of the testing samples.

In the classification algorithm, k is a user-defined constant, and an unlabelled vector (a query or test point) is classified by assigning the label which is most frequent among the k training samples nearest to that query point. Normally Euclidean distance is used as the distance metric; however this is only applicable to continuous variables. In cases such as text classification, another metric such as the overlap metric (or Hamming distance) can be used.

3. Experimental results

In order to further verify the effectiveness of the proposed method, the automatic facial expression recognition system has been developed in Visual C++ to graphically. In general, given an input face image, the expression category that the input image belongs to might be different. Fig.1 is a test recognition example using the user interface of the proposed system.

Figure.1 The test result of expression recognition

4. Conclusions and future work

In this paper, we have presented an automatic facial expression recognition system utilizing visual C++, which adopts the wavelets to extract facial feature and an KNN classify the facial expression emotion. A new approach to facial expression feature extraction based on classification improved has been presented. It is robust to expression. The features for facial representation are selected by PCA. The KNN is used to classify the facial expression characterization. There are deficiencies of the proposed approach, such as the fiducial locations in the human face from where the filter responses are sampled should been extended. The effectiveness of extraction expression feature is completely dependent on the effectiveness of pre-processing of the raw image.

Further work involves taking many effective measures to improve the recognition accuracy. Such as design effective primitive features without any pre-processed on the facial expression images. In addition, because of the weightings of different parts of the face should be different to improve the performance. The nose movement obviously contains less useful information than eyebrow and mouth movement about facial expression. So, the weighting of nose movement may be decreased for improve the recognition efficiency. Mixed-emotions (for example, happiness and surprise, fear and disgust) that may occur in the human face, it should concentrate to the study.

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